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CONTACT SPRAYS FOR THE JAPANESE BEETLE

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INTRODUCTION

Japanese beetles feed on many trees, shrubs, and flowers, some vegetables, and weeds, and, having a definite attraction for one another, they tend to gather in enormous numbers on the food plants in favorable localities. They feed on the soft tissue of the leaves, skeletonizing them wholly, or in part; they damage the blooms of shrub-althea, rose, hollyhock, dahlia, and other flowers, and are especially injurious to ripening fruit. The beetles have been known to become so numerous that even large trees were completely defoliated within a few days.

There is general public interest in sprays for combating the Japanese beetle. Two types of sprays have been developed for this purpose: (1) The protective sprays which form a repellent residue on the plants and largely deter the beetles from feeding, and (2) the contact sprays which destroy many of the beetles but do not necessarily give protection to the plants. Most of the shade trees, ornamental shrubs, and fruit trees can be protected from injury by maintaining a protective residue over all portions of the plants. The timeliness and the thoroughness of the application of these protective sprays are often of more importance than the ingredients. The details of the preparation and the application of the protective sprays are given in Circular 237 of the United States Department of Agriculture. In some isolated localities within the heavily infested area, and at points remote from the general infestation, it is desirable not only to protect the foliage but to kill as many beetles as possible. Contact sprays, along with the mechanical trap and the treatment of soil, have a definite place in the program of reducing the beetle population under these conditions.

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[1] Research with contact sprays against the Japanese beetle has been carried on for several years by B. R. Leach, F. J. Brinley, William Moore, P. A. Van der Meulen, and E. R. Van Leeuwen, formerly of the staff of the Japanese-beetle laboratory at Moorestown, N.J., and by the writer. The results of certain phases of the investigations have been published in New Jersey Department of Agriculture Circulars 92 and 142 and in scientific journals. This scattered information has been collected and condensed by the writer and is made available to the general public in this circular.

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Hundreds of mixtures have been tested, with varying degrees of success, as contact sprays against the Japanese beetle. Many of them are effective in killing the insect; unfortunately, in most cases, the concentration required to destroy the beetle has proved injurious to plants. While concentrated soap sprays are the most economical and effective contact sprays against the beetle, the use of these sprays is limited because of the detrimental effect on foliage. Various materials have been added to dilute soap solutions in an effort to increase the insecticidal value without damaging the plants. Among these materials the oleoresin of pyrethrum flowers (*Chrysanthemum cinerariaefolium* Trev.) has given the most satisfactory results. When a spray containing oleoresin of pyrethrum flowers and a small quantity of soap is applied to the beetles, most of them are paralyzed temporarily, but few of them are killed. By increasing the quantity of soap to approximately 6 pounds and adding 9.5 ounces of oleoresin of pyrethrum flowers to 50 gallons of water, an efficient insecticidal spray was obtained which has been used without detrimental effects on plants.

PREPARATION OF PYRETHRUM SPRAYS

It is generally as economical and more practical for the average individual to use some proprietary insecticide on the market, the formula of which is based largely on formulas developed at this laboratory, than to attempt to prepare it; however, the method of preparing the pyrethrum sprays is given for the information of manufacturers and others having the proper facilities who desire to prepare them. Either of the following formulas may be used:

Formula 1

Commercial oleoresin of pyrethrum flowers	9.5 ounces.
Oleic acid, U.S.P	5 pounds.
Sodium hydroxide, C.P	11.2 ounces.
Water	2.5 gallons.

In preparing this pyrethrum spray the oleic acid and 2.25 gallons of water are placed in a suitable container and heated to 160° F. After this mixture has been removed from the fire, the sodium hydroxide, previously dissolved in 1 quart of water, is poured slowly, with constant stirring, into the oleic acid-water mixture and the stirring continued until a clear product is obtained. While the soap solution is hot, the commercial oleoresin of pyrethrum is added, and the stirring is continued until the mixture is uniform.

Formula 2

Extract of pyrethrum flowers	9.5 ounces.
Mixed fatty acids from coconut oil	5 pounds.
Sodium hydroxide, C.P	15.2 ounces.
Sodium silicate solution (40° to 42° Baume, composed approximately of 9 percent Na_2O, 29 percent SiO_2 and 62 percent water)	9 fluid ounces.
Water	2.5 gallons.

The free fatty acids of coconut oil are prepared by any of the usual methods. For this formula these fatty acids should have the following approximate values: An acid value of 258–270, an iodine value of 8–10, and a refractive index at 77° F. of 1.44. The pyrethrum extract was generally prepared by treating the flowers with ethyl alcohol, separating the alcoholic extract from the undissolved residue, and distilling off the alcohol, taking precautions to avoid overheating. Other solvents, among which were isopropyl alcohol, naphtha, trichloroethylene, and benzene, have been used to extract the active principle from the pyrethrum flowers. The insecticidal tests have not been conclusive, but there appeared to be little difference in the killing power of the different extracts.

The free fatty acids from coconut oil and 2 gallons of water are placed in a suitable container and heated to approximately 160° F. After this mixture is removed from the fire the sodium hydroxide, previously dissolved in 2 quarts of water, is poured in slowly with constant stirring. The stirring is continued until the liquid becomes clear. Next the extract of pyrethrum flowers is added, while the soap solution is still hot, and the stirring continued until a uniform product is obtained. When the solution is cool the sodium silicate solution is added and the stirring continued until the mixture is uniform.

Both of these pyrethrum soaps are effective as contact sprays against the Japanese beetle; the spray prepared according to formula 2 is, however, somewhat more toxic to the insect. It is well known that mixtures of pyrethrum extract and soaps deteriorate upon standing. The insecticidal value of these mixtures was considerably reduced after being in storage for 1 year. It is necessary, therefore, in order that the maximum effectiveness from these sprays may be obtained, that the pyrethrum soaps be freshly prepared each season.

DILUTION

The quantity of pyrethrum soap, made according to either of the previously described formulas, when added to 47.5 gallons of water, will give a solution of the proper strength to use against the Japanese beetle. The pyrethrum soap containing sodium silicate is a hard soap and should be mixed first with a little warm water so that it can be more easily diluted; the other pyrethrum soap is readily diluted. For use in smaller quantities the pyrethrum soap should be diluted to 20 times its volume with water.

APPLICATION OF CONTACT SPRAYS

The effectiveness of a contact spray against the Japanese beetle depends mainly upon the thoroughness with which the insect is wetted; satisfactory results cannot be obtained unless the insect is completely covered. A few drops of the spray on a beetle is not sufficient to kill it. A coarse drenching spray should be used to wet the beetles thoroughly.

The beetle is most susceptible to contact sprays between 10 a.m. and 4 p.m., when the sun is shining, the temperature is above 80° F., and the relative humidity is comparatively low. As the beetles are active and easily disturbed under these conditions the spray must be applied quickly to drench them. When the weather is cool, the sky is overcast, or rain is falling the beetle is not easily killed by contact sprays. It is practically futile to attempt to use these sprays under adverse weather conditions.

The contact spray is applied to trees and shrubs most satisfactorily by means of a power sprayer. The best results are obtained with an operating pressure of 250 to 500 pounds to the square inch. If two nozzles with spreaders are used, one on each side of the infested plant, and the spray directed in the shape of a fan downward from the top, few beetles will be able to leave without being drenched by the spray. The spray can be applied to low-growing plants in a satisfactory manner by means of a bucket pump.

The infestation of beetles is sometimes too scattered, particularly in lightly infested areas, to make practicable the use of a contact spray. Under favorable weather conditions it is often possible to concentrate these beetles in a comparatively small area by the proper placing of mechanical traps containing geraniol as an attractant or by spraying foliage of noneconomic value with an emulsion of the geraniol and thus making the use of contact sprays practical. (Information on the use of mechanical traps for the Japanese beetle is given in Miscellaneous Publication 147 of the U.S. Department of Agriculture.) The geraniol emulsion is prepared by dissolving 10 grams of U.S.P. oleic acid and 4.5 grams of U.S.P. beta-naphthol in 60 cubic centimeters of geraniol, adding 3 cubic centimeters of sodium hydroxide solution containing 0.5 gram of NaOH per cubic centimeter, shaking until nearly clear, then adding 4 cubic centimeters of water and continuing the shaking until a clear brown liquid is produced. One pint of this emulsion added to 50 gallons of water is the proper concentration for spraying. The odor of geraniol, when sprayed on foliage, is rapidly dissipated, so its influence on the beetles is practically limited to 1 day. The geraniol emulsion should be applied only to plants of noneconomic value because the spray causes some damage to foliage and the beetles feed extensively. The geraniol placed in traps will be attractive to the beetles for several days, or weeks, depending upon the quantity used.

LIMITATIONS OF CONTACT SPRAYS

Contact sprays, when properly applied, will kill a large number of the beetles on the foliage at the time of application, but the use of these sprays will not prevent the plants from becoming reinfested and subsequently injured. The beetle is a strong flier and moves readily from one plant to another. It has been possible to make 2 or 3 applications of these contact sprays to foliage without causing damage, but the continued use of any sprays containing soap is likely to cause some injury to foliage. The usefulness of a contact spray against the Japanese beetle is limited. Although it is effective in killing beetles, it cannot be recommended as a control measure for the protection of plants.

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